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# The DESARC Method: An Effective Approach for University-Industry Cooperation

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***Abstract*— Achieving excellence in software development techniques is an important issue for the organizations that develop advanced software-intensive products. Within this context, software excellence is defined as the adoption of advanced software techniques and methods to cope with the complexity and the needs of modern software systems. However, this is not trivial due to the rapidly changing software technology, continuously increasing existence of large and complex software systems and difficulty in following the developments of the state-of-the-art in computer science. This paper focuses on the last aspect. To overcome this problem, it is necessary to define new ways for efficient university-software industry cooperation since advancements in computer science are largely carried out by universities. The existing university-industry cooperation methods are usually triggered after writing grant proposals to financing organizations and passing through strict selection processes. This is, in general, a very inefficient and tedious process to undertake. Even in a perfect review process, many good ideas may not go through simply because they do not fulfill the necessary procedural requirements. Moreover, industrial people may not be familiar with the methods and jargon used in the selection processes. Even if a project is approved, many times it does not result in a technology transfer to industry since accomplishing academic results is the main objective of such projects. This paper presents an overview of a pilot implementation of our approach termed as "Describe, Search and Acquire the Required Capability" (DESARC), which aims at establishing a more effective identification of research projects, allocation of these research projects to research groups and the cooperation between universities and industry. We discuss the results of the application of the method to two large IT companies in Turkey.**

***Keywords*—achieving software excellence; adoption of modern computer science knowledge; university-industry cooperation methods; the DESARC method**

## I. Introduction

Computer science and technology advances rapidly. This makes software developing companies difficult to follow the advancements effectively. Tight project schedules and limited budget for research and development make this process even harder. As a result, companies have difficulties in achieving the excellence in software science and technology to overcome their technical challenges. Therefore, it is necessary to define new ways for efficient university-software industry cooperation. Current university-industry collaborations are mostly based on governmental grants of university research programs, Joint Ventures (JVs) and Framework Programs (FP6, FP7, etc.). There are some important problems in such collaborations. Firstly, the existing university-industry cooperation methods are based on writing grant proposals to financing organizations and passing through strict selection processes. This is, in general, a very inefficient and tedious process to undertake. Secondly, many good ideas may not go through simply because they do not fulfill the necessary procedural requirements. Thirdly, industrial people may not be familiar with the methods and jargon used in the selection processes. Even if a project is approved, many times it does not result in a technology transfer to industry since accomplishing academic results is the main objective of such projects. A study on European Framework Programs shows that universities actively participated in more than 50% of the projects in all Research JV areas [1]. However, inter-organizational and cross-sector nature of these joint groups causes them to face with significant challenges in achieving effective outcomes [2]. Related studies have shown that participants including firms have divergent motivations and objectives for what they expect to achieve in the collaboration and these factors may even change in time [3].

To overcome these problems, we present the DESARC method [4] to define a more effective industry-university cooperation. The content of this paper is organized as follows: The following section explains the DESARC method. This is followed by the section that describes the results obtained. Finally the paper concludes our findings related to the proposed method.

## II. METHODOLOGY


Fig. 1 The sub-processes of the DESARC method. For simplicity, not all possible iterations are shown.

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Fig. 1 shows the sub-processes of the DESARC method. It is the intention that the method becomes an integral part of the quality improvement processes of an IT company. An important aspect of the method is that it is initiated and managed by the company. Contrary to traditional approaches, company engineers play here the major role in the identification of the research topics. Nevertheless, although the company manages the process, a team of academic consultants jointly carry out the assessment and research definition activities. In addition, the grant giving agencies strongly cooperate with the overall process.

As the first step, a set of candidate software development projects are evaluated. In this stage, the strategically important projects are considered. To this aim, the following aspects of the projects are considered:

- The project should be strategically important for the company.
- The project should be relatively at a later stage of its life cycle.
- The existence of problems, which couldn't be identified clearly.
- The project should have a need for deploying advanced technologies.
- The project should be seen as a stereotype in terms of both structure and domain.

As the second step, a set of development projects are selected for further consideration. The projects are selected from either ongoing or planned projects of the company.

As the third step, meetings are organized with the software development teams of the company. The software architects, the software team leaders, the senior software designers or developers are suitable candidates for attending these meetings. The academic consultants steer these meetings by identifying and discussing questions to reveal the recurring problems, proposing & discussing possible solutions for these problems. Technical challenges in the selected projects are analyzed in detail. If necessary, these steps can be iterated until the most relevant projects are selected and analyzed for consideration. In the fourth step, a set of research topics are identified. This step requires transforming the concerns in the application domain to the concerns in the computer science domain. The problem determination is the first step towards the definition of the research topics. The determination of alternative solutions for the specific problem, the motivation for doing the research, the foreseen challenges during the research study, the return on investment for the company and the reference material which lays down the academic ground for the research constitute the main content of each research topic definition. The definition and elaboration of the research topics are iterative processes. Working groups are built from the software teams. These working groups contribute to the definition and elaboration of the research topics in terms of especially motivation and return on investment which is number one precedence for the company .

Once there is an agreement, in the fifth step the research topics are described in a report. The report includes sections on motivation, description of the domain, research challenges, and references. In the sixth step, the relevant researchers who have the required expertise for the intended research activities are determined.

Next, the prepared research reports are discussed with the prospective researchers. If there is a mutual agreement, the prospective researchers are asked to write a detailed research proposal. It is required that the research proposal includes aspects of strong industry relevance and technology transfer. The so-called "Demand-Driven Industry as Laboratory" approach is adopted in which the research group continuously collaborates with the industry to derive and validate novel solutions for the identified research problems.

As the final step, once the proposal is received it is jointly evaluated by the research evaluation team and the company. If the evaluation is positive, the projects are prioritized and reported to grant giving organizations. The grant giving organization finances the projects if the budget is feasible. This paper reports on these 9 sub-processes which have been carried out for two large IT companies. After the research projects were described in detail, these were grouped and prioritized by considering the relationships and dependencies among the projects.

## III. Results

The DESARC method has been separately applied to two large high-technology IT companies within a period of 11 months. The academic consultants consisted of three researchers from three different universities.

Both companies have presented in total 15 software development projects as examples, among which 8 have been selected as the important candidates to identify the research topics. The analysis of these projects and the corresponding meetings have resulted in 36 and 27 relevant research topics for the first and second company, respectively. Within this context81 Ph.D. positions have been found necessary. Based on the identified topics, 24 academic researchers have been contacted from various EU and Turkish universities. 17 researchers have been invited for an information sharing event held on the 17th of May 2014, in Amsterdam, the Netherlands. With the help of this meeting, the researchers have gained a good understanding of the research objectives, scope of projects and the relationships among them. The research groups have been asked to submit a few pages pre- proposals (or letter of intention) which would indicate the research capabilities and the related reference projects of the targeted research group. All the research groups have showed their interests by submitting their pre-proposals within a few weeks including the financial requirements for the PhD studies. The pre-proposals have been evaluated by the academic consultants. The full proposals will be submitted within six months and the first group of highly prioritized research projects are expected to start in the fall of 2015. The total research budget is estimated as 24 million Euros accommodating 81 PhD thesis studies. Since the identified research projects are related, we have identified the following eight categories:

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- Configurable On-Board Systems
- Modular Simulation Systems
- Mission Critical Enterprise Systems
- Sustainable Auto-Adaptive Systems of Systems
- Adaptive Sensor Fusion Systems
- Avionics Systems
- Communication Systems of Systems
- Mission Critical Hybrid Control Systems

To give an idea about the context of research projects defined, we list the research topics below for the Configurable On-Board Systems:

- System Product-Line Engineering for On-Board Systems (SPLE)
- Integration of Model-Checking with Complementary Approaches for Verifying Product-Lines (MCAP)
- Model-Based Testing, Runtime Verification and Debugging for Verifying Product-Lines (TRDP)
- Methods for Model Based Verification and Validation Techniques for Product-Lines (MVVP)
- Adaptable Component Composition (ACC)
- Context-Dependent Modules (CDM)
- Cloud Optimization On-Board (COOB)
- Availability Through Dynamic System Configuration (ASDC)
- Security Through Dynamic System Configuration (SDSC)
- Multi-Objective Quality Optimization (MOQO)

# IV. Conclusion

In this paper we have discussed an approach for enhancing the research capability of IT companies. The approach is based on the "Describe, Search and Acquire the Required Capability" (DESARC) method. The practical realization of the research projects is based on the so-called demand-driven industry-as-laboratory approach in which academic institutes collaborate with the industry to identify relevant research problems and derive the required solutions.

The DESARC method includes the identification of the research problems, the description of research projects, and the selection of research groups who are experts in the selected domains of the research projects. We have applied the approach for two large software IT companies for a period of 11 months.

Based on the analysis of the existing projects of two IT companies and several workshop meetings we were able to identify 63 key research projects that will be used in further 81 PhD studies allocated to 24 researchers in EU and Turkish universities.

Each research project has been described in detail together with the corresponding IT company and addresses the topics that are both business critical for the company, and tackle novel, hard problems in the state-of-the-art. The identification of the research projects has provided a novel vision for the company and will support achieving excellence in the important domains.

Based on these successful results, we are currently applying this method to a third large IT company. As the future work, we aim to apply the approach in total to four companies.

Since general-purpose proposal selection processes are eliminated and the research definition activities are targeted to the company needs, the DESARC method causes much less overhead. In addition, the method results in the identification of the relevant technological problems and as such the related research activities will likely to have a higher degree of technology transfer than the traditional grant-proposal based research approaches.

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http://www.iserp.info.tr/?lang=en